NYASALAND PROTECTORATE

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DEPARTMENT OF AGRICULTURE
For the year 1944.

PART II.
EXPERIMENTAL WORK.

Shortage of staff and necessary pre-occupation with essential war-time production have inevitably curtailed experimental programmes dealing with native crops and cultural practices, but the Experimental Stations dealing with Tea and Tung have continued to carry out fairly comprehensive investigations into many aspects of these two crops.

TEA.

2. This section covers the work undertaken on the tea crop in Mlanje and Cholo districts with special reference to the investigations carried out on the Mlanje Experimental Station. This work is in the charge of Mr. A. P. S. Forbes, Agricultural Officer.

3. *Down-Pruning Old Tea.*

In view of the local controversy with regard to the treatment of old tea after down-pruning, a simple experiment was laid out on land lent by the Ruo Estates Ltd. designed to investigate present methods and other possibilities. This tea was being cut down to 14 inches as a routine and the experiment consists of the following four treatments :—

(i) Prune down to 14 inches and then tip to 27 inches ; cut across the following year to 22 inches and tip to 26 inches ; prune the next year to 20 inches tipping at 4 inches, and prune up 2 inches yearly, tipping at 4 inches.

(ii) Prune down to 14 inches and then tip at 27 inches ; prune the following year 15 inches and tip 27 inches ; prune up yearly 1 inch tipping at 27 inches until 18 inches pruning level is reached and then tip up 4 inches yearly.

(iii) Prune 14 inches tip 27 inches ; prune 24 inches tip 28 inches ; prune down yearly inch by inch until 20 inches is reached, tipping 4 inches up each year ; thereupon prune up 1 inch yearly until 24 inches is reached, tipping 4 inches yearly.

(iv) Prune 14 inches and tip 18 inches ; prune up 1 inch yearly and tip at 4 inches.

Yield records are now being kept.

4. *Tipping Levels of China Jat Garden and Influence of Pruning Methods on Tipping.*

Following the results obtained from the tipping level and method of pruning investigation on Indian tea, which showed that to tip higher than 4 inches tended to reduce yield in yearly pruned tea, and that 2 inches seemed to be the best tipping level for extended pruning cycle tea, a similar experiment was laid out with China jat, on Ruo Estates, Ltd., in 1941. The experiment was unfortunately ruined by misadventure in 1943 and the investigation was re-started in June this year.

The experiment consists of the following treatments :—

(i) Clean pruned,

(ii) Cut across pruned,

and superimposed on each of these are three tipping treatments :—

(*a*) Tipping 2 inches,

(*b*) Tipping 4 inches,

(*c*) Tipping 6 inches.

The results to the end of 1943 suggested a significant increase in yield when the tea was tipped 2 inches above the pruning level, compared to the 4 inch and 6 inch tip but there was no difference in yield between the 4 inch and 6 inch treatments, although the tendency was for the 4 inch yields to be consistently better than the 6 inch yields. There was no significant difference in the yields of the clean prune over the cut across prune, although the clean prune yields were higher. The interaction between the pruning treatment and the tipping level was also insignificant, indicating that one had no influence on the other.

5. *Investigation of Methods of Pruning and of Extending the Pruning Cycle.*

The first results from the length of pruning cycle and method of pruning investigation were published in 1941 since when, in a period of yearly droughts, a further cycle has been completed.

The treatments were :—

(i) Clean pruned every year.
(ii) Cut across pruned every year.
(iii) Cut across with the centre cleaned out every year.
(iv) Clean pruned 1941, unpruned 1942 and clean pruned 1943.
(v) Cut across pruned 1941, unpruned 1942 and cut across pruned 1943.
(vi) Clean pruned 1941, unpruned 1942 and 1943.

The conclusions reached in 1941 suggested that 4 to 5 year old Indian hybrid tea should be pruned lightly in order to obtain well developed bushes and high yields at an early date. The extended pruning cycle tea gave a significantly greater yield than the clean pruned tea.

The results of the second cycle confirmed the above. In this year, as in the last two years, a 20% increase in yield was obtained with the extended cycle treatments and the lightly pruned treatments over the traditional clean prune. The cumulative effects of the treatments were outstanding, for, when treatments (iv) and (v) were pruned in 1943 the yield after pruning of (iv) was still significantly greater than the yearly pruned tea (i) and the yield of (v) was significantly greater than the yield of (ii). The bushes in treatments (ii) to (v) showed a much better development of the frame than in treatment (i).

Considering these results, and the results obtained from other experiments before the war, it can definitely be stated that the yearly clean pruning of Indian jat significantly reduces the yield of tea and retards the spreading of the bush.

6. *Treatment of Young Tea.*

The treatment of young tea has led to as much controversy in Nyasaland as any other cultural operation.

A field of tea was planted on the Experimental Station in 1942 and an experiment was laid down to investigate existing methods.

The treatments were as follows :—

(i) At twelve months to eighteen months after planting, the young plants were centred (i.e., the central main stems were removed to encourage the bush to spread). The bush was cut level at 14 inches and tipped to 27 inches and then plucked.

(ii) At nine months and onwards the young plants were lightly plucked and the bush was pruned at thirty months for the first time.

(iii) The bush was cut across to 14 inches at eighteen months, tipped at 27 inches, and then up-pruned 2 inches yearly and tipped at 4 inches above pruning level.

(iv) The bush was cut across to 8 inches at eighteen months, tipped at 27 inches, and then pruned to 14 inches at thirty months.

(v) The bush was cut across to 16 inches at eighteen months, left two years and then up-pruned 2 inches yearly.

(vi) The bush was allowed to grow for two and a half years and then pruned at 14 inches and up-pruned 2 inches yearly.

In 1943 a severe drought seriously affected the area and little rain fell between April and the end of November. In that year treatment (ii) gave a significantly higher yield than all the other treatments. This year, considering the records from January to June, treatments (ii) (iv) and (v) gave significantly higher yields than treatments (i) and (vi) ; treatments (i) and (iii) also gave significantly higher yields than treatment (vi). Treatments (ii), (iv) and (v) easily produced the best developed bushes, although the bushes in treatment (ii) tended to throw new branches rather high.

The conclusion which can so far be drawn from this investigation is that young tea responds to hard treatment. The most marked result of all is treatment (ii) which, twenty-seven months after planting, had already yielded 115 lbs. of made tea per acre. It is thought that the old Nyasaland system, of leaving the tea unpruned for two and a half years after planting is unsound, as the tea neither forms a good well developed bush nor pays anything towards its upkeep. It must be borne in mind, however, that the conclusions drawn from the results to date may be radically changed in the later history of the experiment.

7. *Spacing of Tea.*

This experiment was laid out in 1938 to investigate the optimum spacing of tea.

The treatments were :—

(i) $3\frac{1}{2}$ feet by $3\frac{1}{2}$ feet.
(ii) 4 feet by 4 feet.
(iii) $4\frac{1}{2}$ feet by $4\frac{1}{2}$ feet.
(iv) 5 feet by 5 feet.

In 1943 treatment (i) gave a significantly higher yield than all the other treatments, and treatment (ii) was significantly higher than treatment (iv).

The tea was pruned in April this year after an extended cycle of seventeen months, and records were kept from December to March.

Although there was no significant difference between the yields over this period the results indicated that the closer the spacing the higher the yield.

8. *Time of Application of Fertilizer to Tea.*

This experiment was laid out with the following treatments :—

(i) Whole application of fertilizer, applied in first week of November.
(ii) Whole applied in the first week of January.
(iii) Half application in the first week of November and half in the first week of January.
(iv) Half application in the first week of November and half in the first week of March.

A mixed fertilizer consisting of Nitrogen, Phosphate and Potash in the proportion 4 : 2 : 2 and applied at the rate of 170 lbs. per acre was used, with the exception that in 1943 only Sulphate of Ammonia was applied.

Apart from the 1943 result, which showed that there was a significant increase in yield when half the fertilizer was applied at the beginning of March and half at the beginning of November, this year, like 1942, gave an inconclusive result. As in 1942 treatment (iv) gave the highest yield but not significantly so, and the results of the other treatments have varied from year to year.

9. *Investigation into the Effect of the Yield of Tea of Sulphate of Ammonia and Sulphate of Potash.*

This is a randomised block experiment comparing :—

(i) No sulphate of ammonia.
(ii) Half ounce sulphate of ammonia per bush.
(iii) One ounce sulphate of ammonia per bush.
(iv) One and a half ounces sulphate of ammonia per bush.

Superimposed is the application of
(*a*) No sulphate of potash.
(*b*) Quarter ounce of sulphate of potash per bush.

Once again the sulphate of ammonia gave a significantly higher yield than the control and although the yields increased with increase in application the difference was not significant.

The potash had no effect on yield and the interaction was insignificant (i.e., potash when applied with sulphate of ammonia did not make the sulphate of ammonia more effective).

10. *Cultivation Experiment.*

This experiment was laid down at the end of 1941 and consisted of the following treatments :—

(i) Hand weeding.
(ii) Weeds slashed down.
(iii) Weeds hoed and carried off.
(iv) Weeds hoed and buried.
(v) Weeds hoed and left on the surface.
(vi) Left unweeded.

So far the results have been inconclusive, but two outstanding points have emerged, which may be related. The first is the superiority year after year of hand-weeding, and the second is that a 'dirty' field does not seem to depress the yields as is generally supposed. Only in 1943, when the experiment was pruned early and suffered a severe set back with the drought, did the yields drop in the unweeded plots.

This year the hand-weeding treatment gave a significantly higher yield than all the treatments except (iv) and (vi), and the unweeded treatment actually gave a significantly higher yield than the hoed treatment with the weeds left on the surface ; usually all the hoeing treatments give the same yield.

11. *Treatment of Nursery Beds with Inorganic and Organic Fertilizer.*

The following experiment was laid out in 1943 to investigate the influence of different organic and inorganic fertilizers on the growth of tea plants. The experiment was a randomised block with the following treatments :—

(i) Control, no manure.
(ii) Sulphate of Ammonia.
(iii) Nitrate of Soda.
(iv) Fish Meal.
(v) Compost.

The same amount of nitrogen was applied to each plot.

The results show that during the past two seasons fertilizing nursery beds neither increased the weight of the stumps, the diameter of the stumps nor the weight of the tops under the conditions of the experiment.

12. *Time of Application of Water to Tea Seed Beds.*

Watering seed beds is the most expensive part in the production of tea plants and the following experiment was designed to investigate the effect on the plants of different times of watering.

(i) Morning and evening.
(ii) Morning.
(iii) Evening.
(iv) Morning and evening, watering on Wednesday and Saturday.
(v) Morning and evening watering on Saturday.
(vi) No water.

The results from this experiment were of general interest. A daily morning watering (ii), a morning and evening watering each day (i) and a watering on Wednesday and Saturday (iv) gave significantly larger stumps and a significantly larger number of stumps per unit area, than doing no watering at all or watering once a week on Saturday. Treatments (i) and (iii) were lower than (ii) and (iv) but not significantly so. Treatments (i), (ii), (iii) and (iv) gave a significantly higher yield of tops than treatment (vi) ; treatments (i), (ii) and (iv) gave a significantly higher yield of tops than treatment (v). The second cycle of this experiment was commenced in March this year.

13. *Spacing Distance of Tea Seed in the Nursery Bed.*

This experiment consisted of a randomised block with four spacing treatments.

(i) 9 inches by 9 inches.
(ii) 9 inches by 6 inches.
(iii) 6 inches by 6 inches.
(iv) 6 inches by 3 inches.

The beds received the normal nursery treatment and the stumps were dug up for planting out eighteen months after planting the seed.

The results showed that under the conditions of the experiment the optimum spacing, to obtain the maximum number of plants of a suitable size for planting out at eighteen months, was 6 inches between the plants and 6 inches between the rows. The average diameter of the stumps in this treatment was 11.8 millimetres (i.e., just less than half an inch in diameter). The next cycle of this experiment was laid down in March, 1944.

14. *Selection of High Yielding Tea Bushes.*

So far this work has been hampered by an insufficiency of staff. Weekly yield records were kept of 1,600 selected high yielding bushes since 1942 but the results so far have been unsatisfactory. Very few bushes have maintained their yield, not only from year to year but from quarter to quarter. The periodic adverse weather conditions, which have upset normal tea culture, have, in a similar manner, upset the selected bushes. As resistance to drought is an important factor in the yearly dry weather conditions in this country, a bush which maintains its yield under such conditions is more likely to be useful than a bush selected under optimum conditions. The selections were reduced to 32 and as soon as a final selection is made, clone trials will be carried out under a variety of soil and climatic conditions.

TUNG EXPERIMENTAL STATION.

15. *Introduction.*

The main aim of the work of this station has continued to be the production of improved planting material of the species *Aleurites montana*. This is being attempted by the selection of promising mother trees, their propagation as buddings on seedling rootstocks, the production of legitimate seedling families by selfing or crossing between high yielding trees, and the use of certain other types of selected seed. Various cultural and manurial experiments are also in progress with this species. From 1940 to 1942 a certain amount of selection work was also done with *Aleurites fordii* and three field trials were started to test buddings and other types of planting material. Since that time, however, it has become clear that *A. fordii* is unsuited to Nyasaland conditions and the field trials have made very poor growth, indicating that there is little or no hope of improving matters by the use of buddings. There has consequently been no extension of the work with this species, and, as the existing experiments have not given results of any value, no further reference to *A. fordii* is made in this report.

16. *The Selection of Promising Mother Trees.*

The work of selecting promising mother trees from plantations in bearing on estates was again expanded by a survey of nearly 8,000 new trees, bringing the total number of trees so far examined to 27,488, from which 479 provisional selections have been made. The plantations covered by this survey are examined annually for several years as it is impossible to pick out all the best trees in a single year, and yield records are taken from all the selected trees in order that in due course the best of them may be chosen for propagation as buddings. This work has been handicapped by the fact that almost all the *montana* plantations in Nyasaland are young and selection from such areas is not as satisfactory as it would be if more mature trees were available. The yields of individual young trees show considerable variation from year to year and many selections which bore heavily in their first recorded year have not subsequently maintained their early promise. There has also undoubtedly been a tendency to select trees which are merely precocious and it is probable that many of these will be surpassed in later years by

slower maturing trees. In spite of these difficulties, however, a number of outstanding trees have been found and the work will no doubt yield greater results as the trees become older. Further details may be found in a report recently published. (Webster and Selby: "Progress Report on the Selection and Vegetative Propagation of Promising Tung Trees": Nyasaland Agric. Quarterly Journal IV. 4. 1., October 1944).

17. The yields of all trees at the Zomba Experimental Stations were again individually recorded and a summary of these yields, together with those of previous years, is shown in Table 1. A severe hail-storm, which occurred just after the fruit had been set, did much damage to fruit and foliage and greatly reduced the 1944 crop.

TABLE 1. ZOMBA EXPERIMENTAL STATION, YIELDS, LBS. DRY SEED.

When Planted	1931/32		1934/35		1935/36		1936/37		1937/38	
No. of trees	123		55		211		97		69	
Age, years	per tree	per acre	per tree	per acre	per tree	per acre	per tree	per acre	per tree	per acre
3	1.5	84	1.7	95	1.8	101				
4	3.2	179	3.2	179					6.0	336
5	5.5	308			5.4	302	6.6	370	7.1	398
6	10.0	560	6.0	336	7.7	431	6.2	347	6.7	375
7	11.8	661	12.1	678	8.2	459	4.7	263		
8	13.7	767	10.6	594	5.8	325				
9	15.1	846	6.7	375						
10	20.5	1,148								
11	18.7	1,047								
12	8.5	478								

18. *Vegetative Propagation.*

(*a*) *Clone Testing, and Comparison of Buddings with Seedlings.* After several years of yield recording the more promising of the selected trees mentioned above are being propagated as buddings on seedling rootstocks and the resulting clones planted in field trials for comparison. Final selection will, of course, be based on the performance of the buddings rather than on that of the mother tree itself. When this season's planting is completed there will be 68 clones under trial at the station, of which 53 are planted in full scale field trials and 15 in small single plots. Clones are being tested in six experiments at the station, but only two of these are yet in bearing.

(*b*) Experiment No. 1, which was planted in December, 1940, compares unselected seedlings, open pollinated seedlings from four selected trees, and buddings of the same four selections on both *montana* and *fordii* rootstocks. Measurements of girth taken during the dormant season again showed that both types of seedling have made more growth than the buddings, and that the buddings on *montana* stocks are more vigorous than those on *fordii* roots. (Table 2). These differences in vigour are now readily apparent to the observer from the general appearance of the trees, and the dwarfing effect of the *fordii* stock is particularly noticeable. On account of the rather poor soil of this field, yields have been low, but the buddings gave significantly greater yields than the seedlings. There was no significant difference in the effect of the two rootstocks on yield. (Table 2). Differences in yield between clones were also apparent. (Table 3).

TABLE 2. EXPT. NO. 1 BUDDINGS V. SEEDLINGS, AND ROOTSTOCKS TRIAL.

	Buddings		Seedlings		Significant Difference
	Montana Stock	Fordii Stock	Selected	Unselected	
Mean yield, lb. dry seed in $\frac{1}{4}$ in.	46.54	38.07	56.20	54.62	6.11 (p = 0.01)
Mean girth per tree ...	1.85	1.69	0.89	0.69	0.50 (p = 0.01)

TABLE 3. EXPT. NO. 1. YIELDS OF BUDDINGS ON MONTANA STOCK, LB. DRY PER TREE.

M8	M13	H14	F9
1.55	1.90	2.50	1.25

Sig. differences: 0.56 (p = 0.05).
0.77 (p = 0.01).

(*c*) Buddings have also given significantly better yields than seedlings in a trial at Namingomba Estate, but in this trial differences between clones are only significant in one instance as owing to the small size of the plots only large differences can be shown to be real. The two new clone trials at Lujeri and Chingaluwe have not yet begun to bear.

TABLE 4. EXPT. A. YIELDS IN LBS. DRY SEED PER TREE.

Age Years	Buddings	Seedlings	Clones				
			M8	M13	F9	N24	N10
2	3.31 Sig. diff. (p = 0.01)	1.50 0.89	2.89 Sig.	5.95 diff.	2.81 1.49	2.69 (p = 0.05)	2.23
3	3.06 Sig. diff. (p = 0.01)	1.47 1.46	3.43	4.25	2.01 No	2.97 sig.	2.64 diff.

(*d*) Further yield records from buddings two and three years old are available from Expt. No. 2 at the station (Table 5) and from some small plots of buddings at Kamponje Estate. (Table 6). The results are not quite up to expectations, but at only 3 years old the trees have scarcely been given an opportunity to show what they can do and no conclusions of any value regarding their relative merits can be drawn for at least another two years. It may be mentioned that many of these early buddings are derived from mother trees which have not subsequently proved to be among the best yielders.

TABLE 5. EXPT. NO. 2. YIELDS OF CLONES UNDER SOYA BEANS, LBS. DRY SEED PER TREE.

Clone	M8	N24	F9	14	10
At 2 years...	0.43	1.03	0.77	2.37	3.07
At 3 years...	2.22	3.04	3.65	7.72	7.57

TABLE 6. YIELDS OF CLONES AT KAMPONJE, LBS. DRY SEED PER TREE.

Clone :	L22	O23	14	H14	M8	O3	F9	K3	O19	4	10	N23	O8	M13
No. of trees per clone	20	19	20	10	20	10	5	13	9	20	20	7	9	12
At 2 years ...	4.0	5.1	7.8	2.9	2.4	2.7	1.9	2.8	2.5	2.6	4.5	5.5	8.6	9.6
At 3 years ...	2.9	4.0	4.6	2.2	2.4	5.8	2.5	5.8	2.9	1.8	1.3	3.6	7.8	4.1

19. (*a*) *Clonal Characteristics.* In spite of the fact that all budding has been done on seedling stocks, which must necessarily introduce some degree of variation amongst the resulting composite plants, certain characteristics of the mother trees are reproduced with remarkable uniformity in all the buddings derived from them, and there are differences between clones in vigour, habit, flowering and fruiting. Although no detailed study has yet been made of the variation in vigour and habit exhibited by a number of clones it is clear that the majority of clones belong to one or other of two very distinct types. Type A grows vigorously, tends to make its first branches relatively high, and thereafter produces whorl after whorl of primary branches one above the other at fairly long intervals on the main trunk, resulting in a strong growing, erect and open type of tree. Type B is less vigorous, branches low and at very short intervals and has little tendency to increase in height, thus making low, dense, bushy trees. The latter type produces far more potential fruiting points in the early years than the former and is usually much more precocious in bearing. It cannot yet be said which of these types is likely to prove the more profitable. The early fruiting of type B and the rapidity with which it shades the ground and reduces weed growth, are advantages, but the greater vigour of type A may easily mean that trees of this kind will in due course prove superior in yield.

(*b*) Clonal differences in flowering habit are also evident, and an investigation has been put in hand in order to see if these are correlated with yield. Ten flower clusters on each of 30 trees of the five clones in Experiment No. 2 have been examined and a record made of the number of male and female flowers per cluster, the percentage of female flowers setting fruit and the number of seed produced per female

flower. The main interest of this investigation lies in the possible correlations which may exist between these factors and yield, and these cannot be determined until the 1945 crop is harvested. As can be seen from Table 7, however, significant differences between clones are apparent in respect of several of the characteristics already recorded.

TABLE 7. FLOWERING CHARACTERISTICS OF FIVE CLONES.

(*Means of* 300 *clusters*—10 *clusters on each of* 30 *trees per clone*)

Characteristic	Clones					Sig. diff. (p = 0.01)	Remarks
	14	10	N24	N8	F9		
Females per cluster	12.58	21.31	21.14	13.70	26.61	4.78	F9 > all others. N24 and 10 > 14 and M8
Percentage male flower ...	8.51	0.56	0.36	0.72	5.37		
Percentage females setting fruit	26.03	15.01	18.15	15.59	13.58	4.493	14 > all others. N24 > F9
Seed per female flower ...	0.757	0.436	0.499	0.395	0.359	0.141	14 > all others. N24 > F9

(*c*) Further observations on the flowering of the five clones mentioned above were made in connection with the question of pollination in budded plantations. A record was made at three day intervals of the type of flower open on each tree (72 trees in each clone). Similar records were taken at five day intervals in 1943. None of the trees produced more than a few male flowers and the proportion of males to the total number of flowers, as can be seen from Table 7 was only from 0.36% to 8.51%. This year's results bring out the same points as last year ; namely, that some clones (14 and 10) produce no pollen at all during the early part of their flowering season, during which period, however, an abundance of female flowers is opened ; while in other clones (10 and N24) the amount of male flower produced is so small that even when available it could hardly be adequate for proper pollination. Thus the need for planting a small proportion of early flowering male trees to provide for pollination in a budded plantation is again indicated. These records are being repeated for several years in order to ascertain if the flowering habit of the trees changes as they grow older. In three of the clones (14, F9 and M8) rather more trees produced male flowers this year than last.

(*d*) The precocious fruiting common to many Type B trees has already been mentioned (para. 3. 21), and some clones of this type tend to fruit heavily so early that vigour is impaired and a certain amount of dieback and biennial bearing may result. These features are exhibited most markedly by the clone N4, which commonly sets a crop only one year after budding. This clone has been extensively planted on one estate and advantage has been taken of this fact to experiment on the effect of thinning various proportions of the crop with the idea that such thinning during the first two or three years may permit of strong growth being made by the tree, after which it would be capable of carrying regular heavy crops without ill effects. The buddings in the trial, which were one year old when it was begun in 1943, were divided into three classes on the basis of the number of fruit which they were carrying :—(*a*) 21-60 fruit, (*b*) 61-100 fruit, (*c*) over 100 fruit. In each group the trees have been subjected to four treatments in 1943 and 1944 :—(1) No thinning, (2) removal of 20% of the crop, (3) removal of 30% of the crop, (4) removal of 50% of the crop. The thinning naturally had no effect on the crop harvested in 1944, but girth measurements and the number of fruit set in the 1944/45 crop indicate that with trees in groups (*b*) and (*c*) the thinning has probably had some effect in causing them to make better growth and set more fruit. (Table 8.) The treatments will be repeated for 3 years and their effect on the subsequent performance of the trees then noted.

TABLE 8. FRUIT THINNING TRIAL.

Fruiting group 1943	Amount of thinning				Remarks
	Nil	20%	30%	50%	
I. Increase in girth as percentage of original girth.					
(*a*) 21-60 fruit	20.6	19.7	20.0	21.6	No sig. diff.
(*b*) 61-100 ,, ...	15.9	18.7	18.2	21.2	50% > nil.
(*c*) over 100 ,, ...	15.2	14.8	18.6	20.7	No sig. diff.
II. No. of fruit set 1944 *as percentage of No. set* 1943.					
(*a*) 21-60 fruit	338.7	446.3	315.1	375.7	No sig. diff.
(*b*) 61-100 ,, ...	179.3	189.9	208.5	227.5	50% > nil.
(*c*) over 100 ,, ...	118.4	122.1	151.9	196.6	50% > nil.

20. (*a*) *Topworking.*

The topworking of established male trees by budding on the branches with scions from high yielding mother trees was shown to be a successful means of converting them to good bearers in 1941/42, and has since been extensively practised on estates. Topworking trials at Naminkweya and Mandimwe gave results of some value in connection with certain practical difficulties which have been experienced, and these were mentioned in last year's report. It was stated that budding on the secondary branches

appeared preferable to budding on the primaries as it resulted in less wind damage and dieback, but that as budding on the secondaries is more expensive than working only the primaries no opinion as to which is the more profitable method could be expressed until comparative figures for yields and returns are available. The first yields from the Naminkweya trees were obtained this year and it will be seen that the trees budded on their secondary branches outyielded the others in all cases except where the clone NK 7 was used as scions (Table 9). This interaction between clone and method of topworking was unexpected and cannot be explained at the moment. Further records are required before a final conclusion can be drawn, but it seems highly probable that the extra yield from budding on the secondaries will more than cover the extra cost in a couple of seasons.

TABLE 9. YIELDS OF TOPWORKED TREES, NAMINKWEYA, LBS. DRY SEED PER TREE.

Scions	Budded on	
	Secondaries	Primaries
NK 8	12.7	6.5
NK 7	10.4	14.9
NK 6	6.5	2.4
NK 5	8.8	3.5
All trees	10.1	7.5

(*b*) The first crop is now being produced on an experiment at Mandimwe which compares various clones when used as scions for topworking. In this trial four of the main branches on each male tree were selected, and each branch was budded with one of four clones to be tested. Ten clones are compared in this manner in three trials containing 25 trees each, the standard clone, M8, appearing in all trials. The number of fruit has been counted, and, as will be seen from Table 10, there are significant differences between some of the clones in their first crop.

TABLE 10. MANDIMWE; COMPARISON OF CLONES AS SCIONS FOR TOPWORKING. MEAN NUMBERS OF FRUIT PER BRANCH.

	Clones				Remarks
Trial No. 1	M8	M13	B742	10	B742 better than M8, M13 (p =0.01)
	33.6	33.6	79.1	65.0	10 ,, ,, ,, (p =0.01)
Trial No. 2 ...	M8	H14	14	N4	N4 better than all others (p =0.01)
	21.1	40.1	52.9	81.6	14 ,, ,, M8 (p = 0.01)
Trial No. 3 ...	M8	F9	O23	Nil	O23 ,, ,, F9 (0.05) and M8 (0.01)
	24.2	30.9	49.2	35.9	Nil ,, ,, M8 (p = 0.02)

21. *Production of Legitimate Seed.*

Artificial crossing and selfing of selected trees was carried out in 1942 and 1943 with the object of raising a small number of legitimate seedling families from which it is hoped later to produce improved planting material by vegetative propagation from the best individuals. No further crosses were made this year but some 290 seedlings resulting from last year's work are being planted out for trial. This brings the total number of such plants now under observation to 760.

22. *Use of Selected Illegitimate Seed.*

(*a*) *Seed from selected high yielders.* Plants raised from open pollinated seed taken from selected high yielding trees are planted in two experiments but no fruit has yet been produced in these trials. It is not expected that simple seed selection of this kind will be of much value.

(*b*) *Clonal Seed.* Three small isolated gardens were planted with buddings in 1941 with the object of finding out if by crossing between themselves these buddings would produce improved seed of any value. One of the gardens contained mixed buddings and the other two are small monoclone blocks. The first crop of seed was obtained in 1944 and seedlings derived from it have now been planted out in a trial consisting of 55 blocks of 4 trees each—one seedling from each isolated garden and one budding of the standard clone M8. A number of the clonal seedlings have also been planted in addition to this trial. Unless the progeny of one of these plots is found to contain an unusually small proportion of males it is not expected that this clonal seed will give results comparable to those obtainable from buddings.

23. *Cultural and Manurial Experiments.*

(*a*) *Intercropping Trial.* This experiment compares the effect of intercropping tung trees for the first 3 or 4 years with soya beans, maize, velvet beans dug in annually as a green manure, and a cover crop of *Calapogonium mucunoides*. Annual crops have now been grown for four seasons, the *calapogonium*, which was intended to be permanent, dying out early in the fourth season owing to its failure to seed.

Intercropping has now ceased and all plots are being put under a cover crop, but the full effects of the early treatments will not be apparent until records for several more years are available. The results for the first two crops are shown in Table 2. In the first year the yields of plots under soya beans or maize were significantly better than those from the velvet bean or *calapogonium* plots, but in the second year, although the soya plots maintained their superiority, the yields from the maize plots fell, due no doubt to the effect of four consecutive maize crops. In 1944 the differences between maize or velvet bean plots and the *calapogonium* plots just fail to reach significance. In both years, vigour, as indicated by girth measurements, was greater on the soya plots than on any of the others, and greater on the maize plots than on those under *calapogonium*.

TABLE 11. INTERCROPPING TRIAL: YIELDS IN LBS. DRY SEED PER TREE, AND GIRTH AT 3 INCHES ABOVE UNION IN INCHES.

	Intercropped with				Remarks
	Soya S.	Maize M.	Velvet bean V.	Calapog. C.	
1943 Mean yield ...	1.53	1.51	0.77	1.06	S & M greater than V&C.
,, girth ...	10.65	9.15	8.62	8.45	S > all others M > C.
1944 Mean yield ...	4.91	2.33	2.35	1.83	S > greater than others
,, girth ...	13.52	11.88	11.47	10.44	S > all others M > C.

(*b*) *Manurial Experiments.* No results are yet available from the two manurial trials at the station.

(*c*) *Spacing Trial.* Although the question of spacing is one on which it is desirable to obtain information as soon as possible, it was impossible to start a field trial until a relatively large area which could be planted with buddings became available. It is now possible to use such an area at Mandimwe Estate and a spacing trial has therefore been planned. This will compare three spacings applied to three "varieties," viz. (*a*) Type A clone, (*b*) Type B clone, (*c*) a mixture of the two types. The system (*c*), of planting a Type A clone at a relatively wide spacing and interplanting with Type B trees which will come into bearing quickly and be cut out as the Type A trees mature, may probably prove very useful. Two times of thinning will also be compared in this trial. The experiment will not be planted until 1945, but the budding of the 4,000 stocks required is now proceeding.

24. *Miscellaneous.*

(*a*) *Germination Experiments* Three experiments on the storage and germination of tung seeds were carried out but only one of these has been completed at the time of writing. This was a small trial in which seed stratified for 4 months between layers of sand or sawdust was compared with seed stored in a normal manner for the same period. The stratified seed gave a markedly better germination than normal :—

Seed stored in normal manner	49.00%
Seed stratified in sand	79.25%
Seed stratified in sawdust	78.25%

(*b*) *Cover Crops.* A number of cover crops are under trial in an attempt to find one which is really suited for tung. The ideal cover would be easily established and quick growing, perennial, dense but low growing so that it does not conceal fallen fruit, procumbent, free from insect attack, and free seeding. *Indigofera endecaphylla* has been tried on a fair scale, but is not very satisfactory because it is slow to establish itself and is badly attacked by leaf eating beetles. The most promising species at the moment are *Glycine javanica* and an unidentified legume from Southern Rhodesia, probably *Dolichos* sp.

CULTIVATION AND INTERCROPPING EXPERIMENTS ON NATIVE CROPS.

25. (*a*) *Flat* versus *Ridge Cultivation.*

An experiment conducted at Port Herald on the Lower Shire plain (altitude 150') on light sandy alluvium. The customary native practice is to plant mixed crops of sorghum and bulrush-millet on the flat with little or no preliminary cultivation. On sloping land this method permits serious sheet erosion. The local natives are opposed to the formation of contour planting ridges as a check to erosion, and the experiment was designed to determine whether ridges were effective in reducing wash without lowering crop yields.

The following treatments were employed in a 5 x 5 Latin Square with plots of 256 square yards :—

(1) Planting on the flat (control).
(2) Planting on the top of contour ridges.
(3) Planting in the furrows between ridges.
(4) Planting in the furrows, and later splitting ridges back on to the young plants.
(5) Planting on the sides of ridges.

The experiment has been in progress for two successive years.

The variation in plot yields has been considerable and the experimental error high. In consequence no significant differences have been detected, and the only conclusion which can be drawn is that, under the conditions of the experiment, ridge planting does not adversely affect yields. The flat planting treatment has in fact given the lowest returns in each year

(b) Maize Intercropped with Groundnuts.

An experiment conducted at Makanga by Mr. E. O. Pearson of the Empire Cotton Growing Corporation on the Lower Shire plain at an altitude of 170′ on heavy dark alluvium.

This experiment was planned to test the effect on groundnut yield and rosette incidence of interplanting in maize at various densities and arrangements on the heavy soils of the Lower River. It was hoped that by interplanting in maize the usual ill-effects of late planting could be avoided and harvesting of nuts effected without losses due to premature germination, as often follows early planting.

Small ridges were made 3 feet apart and maize planted in the furrows on 7/12/43. Groundnuts were planted on the ridges on 17/1/44. This was 1-2 weeks later than had been intended. Maize was harvested on 29/4/44 (144 days) and groundnuts on 5/5/44 (109 days). A bulk maize originally derived from the E.C.G.C., Domira Bay, and stronger growing than local maize was used, and Gambia Bunch groundnuts.

The experiment was a randomised block with five replications using the following treatments :—

A. Pure stand maize, holes 3 feet apart in the row, 2 plants per hole.

B. Maize in every row, holes 3 feet apart, 2 p.p.h. ; groundnuts on every ridge (i.e., 18 inches from the maize rows), planted both sides of the ridge, holes 1 foot apart but staggered, a hole on one side of the ridge coming opposite a gap on the other. This spacing has been most effective at Domira Bay.

C. As above, but maize holes 4 feet apart in the row, 3 p.p.h.

D. Maize on every alternate row, holes 3 feet apart in the row, thinned to 2 p.p.h. ; groundnuts on every ridge, planted as above. There are thus two rows of groundnuts to every row of maize, the latter rows being 6 feet apart.

E. Pure stand groundnuts.

The groundnuts populations are thus the same in all treatments ; the maize populations are the same in treatments A, B and C, though differently arranged in the last, and are halved in treatment D.

The yields per acre are shown below in lbs. of cobs and unshelled nuts. These yields are shown in brackets converted to maize grain at 75% shelling out-turn and nuts at 66.7% shelling out-turn, and the equivalent net cash return per acre is shown, reckoning maize at ¼d. per lb. and groundnuts at 2d. per lb. An allowance is made for seed rate at 36 lbs./acre of maize and 55 lbs. acre of groundnuts.

Treatment	Yields, lbs. Per Acre		Net Cash Return		
	Maize	Groundnuts	Maize	Groundnuts	Total
A	2,500 (1,875) ...	—	38/4	—	38/4
B	2,215 (1,661) (*)	139 (93) ...	33/10	6/4	40/2
C	2,622 (1,890) ...	170 (113)	38/7	9/8	48/3
D	1,210 (907) ...	341 (227) ...	18/2	28/8	46/10
E	—	594 (396) ...	—	56/10	56/10

(*) Yield lowered by one bad plot, should be about 1,990 lbs. grain.

Differences significant at P = 0.05, maize 437 lbs. grain/acre, groundnuts 72 lbs. shelled nuts/acre.

The yields of groundnuts throughout were low, the pure stand being less than half that normally obtained at the Cotton Experimental Station, Domira Bay. Previously at Makanga yields as high as 1,000 lbs. (unshelled) and as low as 330 lbs. (unshelled) have been obtained in a bad rosette year. Considering the very late planting, however, the results warrant further experiment. There was not much rosette visible on the experiment as a whole ; the plots were small (22 yards square) and so the pure stand groundnuts may have been protected by adjacent plots of maize, but it is thought that it was not a year of bad aphis attack and cannot therefore be regarded as a convincing demonstration of the effect of intercropping on rosette.

The groundnuts had no effect on the yield of maize (cf. treatments A, B and C), but spacing the maize at 6 feet x 3 feet halved the maize crop and doubled the groundnuts. Yields of maize were low in comparison with other fields at Makanga in better heart on which rather higher plant populations were used, and where yields of 1¼ tons of maize grain per acre were obtained. On these fields there was only a drop of about one-third when the 6 feet maize spacing was used.

It is possible that using maize in rows 6 feet apart and very closely spaced in the row, yields might be only slightly below those obtained with the normal native spacing (about 3 feet x 4 feet) and, using a double ridge of groundnuts between these wide rows, a yield of 400 lbs./acre of shelled nuts obtained. At present groundnut prices this would yield just about double the cash return obtained from cotton at present prices and yields.

(c) *Cotton Weeding Experiment.*

An experiment conducted by the Cotton Specialist of the Empire Cotton Growing Corporation at Domira Bay (2,000 feet).

The experiment was based on a five acre field of Mz. 561 bulk cotton and consisted of the following variables, in a randomised block layout using eight replications.

Main Treatments.

A. Plots hand-hoed and *cleaned before thinning.*

B. Plots hand-hoed and *cleaned after thinning.*

Sub-treatments.

1. Plots given *one subsequent cleaning.*

2. Plots given *two subsequent cleanings.*

Variables were A1 and A2, B1 and B2, four in all, making a total of thirty-two plots. Plots were 110 yards long by 5 yards wide.

A2 plots approximate to normal Station practice in cotton cultivation, B1 plots to the general run of native gardens. A1 represents about the best we can expect of the native in his present state of agricultural education.

The treatment effects were assessed by the seed cotton yields and the results are given hereunder in percentage form, using the A2 plots as standard = 100.

Variables	Yields as seed cotton	Differences
A2	100	Sig. diff. = 10 (P = 0.05)
	Mean 91.5	*A2—A1 17*
A1	83	
		Mean A—Mean B 58.5
B2	40	
	Mean 33	*B2—B1 14*
B1	26	

The enormous importance of early cleaning is manifest, and this is exactly where the African of the Nyasaland Central Areas so often proves wanting.

(d) In addition to the above experiments others are in progress to test the efficacy of burying maize trash, the relative values of light cultivation and the burial of weeds, and the effects of thorough cultivation prior to planting. These are all designed to elucidate the merits and disadvantages of certain accepted native practices, maize being the principal test crop. No report can be given on the progress of these experiments, which are being conducted at various sites in the Protectorate, as they have not yet been running for a sufficient period.

EXPERIMENTS WITH SPECIFIC CROPS.

26. (a) *Cotton.* The Cotton Specialist of the Empire Cotton Growing Corporation reports that the derivatives of Mz.561 were planted in multiplication plots and in a small bulk trial for comparison with the parent bulk, Crown Land commercial U.4, our two U.4 x Cambodia x U.4 crosses, N.C.-4 and N.C.-7, and the first Crown Land U.4 selection to breed true, Crown Land—119.

The final pickings showed that nine of the derivatives were significantly better yielding than Crown Land U.4, and of these four have been selected for further multiplication and trial. One of these, T-3, had far better Jassid resistance than its fellows. Spinning tests kindly carried out by the British Cotton Industry Research Association indicated that in the Mz.561 derivatives we have a better type of lint than that produced by Crown Land U.4. Coupled with good yields this suggests that in Mz.561, Nyasaland version, we may have achieved a real advance.

Yields were good for the site and season ranging from 730 lbs. per acre for the best Mz.561 derivative, T.-3, to 567 lbs. per acre seed cotton for Crown Land U.4.

(b) *Cotton : Insect Pest Control.* The Insect Pest Control section of the Empire Cotton Growing Corporation has continued its investigation into the pests of the Lower River cotton crop, principally Red Bollworm (*Diparopsis Castanea*, Hamps). Work on this problem, which is one of considerable magnitude in the main cotton area of the Protectorate, has been in progress for six years, and investigations are nearing successful completion. A full report of this work and suggestions for the control of the pest are at present being prepared.

27. (*a*) *Rice.* Native paddy in Nyasaland is not irrigated and cultivation depends upon the successful annual flooding of low-lying and riverine areas, and is therefore a somewhat fortuitous pursuit. In recent years irregularities in the rainfall and flooding of rivers have led to premature drying-out of paddy fields with decisive adverse effect upon the principal variety (Faya) which is long-term. Variety trials have therefore been in progress in an attempt to find high-yielding shorter-term types, which nevertheless combine with these attributes the quality which gives Faya its popularity.

The results of one trial in Dedza district at 1,700 feet on flooded river alluvium of high fertility were :—

Variety	Yield of Paddy per acre	No. of Weeks to Maturity
1. Golo (local selection)	4,280	21
2. Burma A 31-12	3,880	20
3. Mbungala (local)	3,360	22
4. Chingongo (,,)	3,080	22
5. Faya (,,)	2,880	24
6. Chaluwa (,,)	2,720	22

Significant difference (P = .05) 540 lbs.

'Golo' is not a high quality rice but popular for local native consumption. 'Burma' has been pronounced as being good quality by the local Indian community.

(*b*) The results of a second trial in North Nyasa, where short-term varieties are needed for the added reason that winter cotton follows summer rice in the same land, were as follows :—

Variety	Yield of Paddy per acre	No. of weeks to Maturity
1. Maji Maji (ex T.T.)	4,000	19
2. Sena Mtebe (,,)	3,936	21½
3. Faya (local)	3,776	21½
4. Afaa Mabawa (ex T.T.)	3,744	21½
5. Kahogo	3,712	21
6. Afaa Mwanza (ex T.T.)	3,264	19
7. Demarara Creole	3,200	19
8. Milli No. 2	2,848	24

Of the above varieties the short-term Demarara Creole has been classed by local Indian consumers as being of excellent quality. Further trials are in progress.

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